International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

The Fungal Species and Fungal Numbers Associated with Non-Rhizosphere Soil of *Spinacea oleracea* (L.) During Kharif and Rabi Seasons

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Abstract

The microbes associated with non-rhizosphere soil, rhizosphere and phylloplane were found to differ quantitatively and qualitatively. The study of such associations are of special interest in the study of microbial ecology. The microbes in turn exert influence on the plants in supplying useful micro and macro nutrients to the above ground community The present study is aimed to study the qualitative and quantitative aspects of fungal species inhabiting the Non-Rhizosphere Soil of *Spinacea oleracea* (L.). The fungal numbers and species were estimated in two Kharif seasons (Kharif season –I and Kharif season -II) and two Rabi seasons (Rabi season –I and Rabi season – II).A total of 68 fungal species were isolated from non-rhizosphere soils.The number of fungal species isolated during Rabi season-I were more than that of Kharif season – I. The dominant groups were Fusaria followed by Sterile mycelia, Fungi imperfecti and Aspergilli which were dominant throughout the Kharif season II. The dominant species during Rabi Season II were Aspergillus niger. Acrophialophora nainiana, Myrothecium gramineum, Aspergillus nidulans, Aspergillus flavus, Phoma humicola, Cladosporium cladosporioides. Fusarium dimerum, Bahupaathra sp. and Curvularia sp.

Key words: Spinacia oleracea, Non-Rhizosphere Soil, Rabi, Kharif, Fungal species

Introduction

The aerial and subterranean portions of the plants are known to be congenial sites for the colonisation of the microbes. The microorganisms are known to interact with each other and with the host plant simultaneously, sometimes resulting in useful effects on the host plant and at other times causing disease conditions. The study of such associations are of special interest in the study of microbial ecology. The microbes associated with non-rhizosphere soil, rhizosphere and phylloplane were found to differ quantitatively and qualitatively. The microbes in turn exert influence on the plants in supplying useful micro and macro nutrients to the above ground community. The discovery of various isolating techniques in isolating diverse groups of microorganisms have revealed that diverse groups of microflora inhabit the soils and they are found in all habitats of the soil on this biosphere and they form an important soil biomass. Number of fungal, bacterial and actinomycetes species were reported to thrive well in the soil. Number of these microbes are very important as they are involved in recycling of organic waste, carbon nitrogen and phosphorous cycles, mineralization etc. The present study is aimed to study the qualitative and quantitative aspects of fungal species inhabiting the Non-Rhizosphere Soil of *Spinacea oleracea* (L.).

Review of Literature

With the discovery of several isolating techniques by several workers such as dilution plate technique by Waksman (1952): soil plate method and modified soil plate methods by Warcup (1950); agar film method (Jones and Mollison, 1948); immersion tube method (Chesters. 1948); immersion plate technique (Thornton, 1952); baiting method (Harvey, 1925); dilution frequency method (Allen, 1949); direct microscopic examination (Conn, 1918); uncoated glass slide (Rossi and Riccardo 1927; Cholodny, 1930), root maceration (Stover and Waite, 1954) and many other

techniques for essaying of microbes resulted in their quantitative and qualitative estimations in ecological niches of the soil.

Soil fungi in relation to habitat in different geographical areas was made by Niethammer (1935). Fungi from cultivated field were reported by several workers (Chand, 1937; Chaudhuri and Sachar, 1934; Ghatak and Roy, 1939; Gosh and Dutta, 1962; Jasevoli, 1924; Singh, 1937) and in soils of high moisture content (Verona, 1934) and uncultivated soils (Bisby et al. 1933, Dixon, 1928), from grass lands (Swartz et al. 1953), fromdifferent soil depths (Paine, 1927; Swift, 1929), Garrett (1956) proposed soil fungi as 'Soil inhabiting' or 'Root inhabiting fungi.Several techniques were used for isolating soil fungi.

Materials and Methods

Spinacia oleracea L. is a greeny leafy vegetable and is commonly known as Indian Palak. These plants are succulent herbs with swollen nodes. This plant comes under Chenopodiaceae which has about 100 genera and 1,500 species. The members of this family are cosmopolitan in distribution. Duration of the crop is 120-130 days. It flowers between 75-105 days after sowing. The plant is commonly used leafy vegetable rich in biotin, riboflavin and other micro and macro nutrients. It is widely grown by the farmers and also in kitchen gardens. For the present study seeds of palak were sown in fifteen 5’ x 5’ plots. Sampling was regularly done for every 20 days. Soil samples were collected with a wedger sterilized with 70% alcohol from the top 5-6" of soil after scraping away an inch of surface soil into sterile containers. (Polythene covers). The samples collected were subjected to microbial, physical and chemical analysis apart from recording soil pH. The general laboratory techniques used for this experiment were adopted as suggested by Booth (1971) and Hawksworth (1974). The media used were Potato Sucrose Agar (PSA) , Vegetable Agar Medium (VAM).

Cultures were maintained on PSA slants and preserved in refrigerator. Subculturing was made at 3-5 months interval. Fungi isolated were maintained on PSA slants. Lactophenol and cotton blue in lactophenol were used as mounting and staining media for preparing semi-permanent slides which were sealed with D.P.X. mountant. Microscopic observation: Meopta Research microscope with adequate high power has been identified used The fungi were photographed using trinocular head. The data obtained was subjected to statistical analysis for drawing precise conclusions on various aspects as suggested by Snedecor and Cochran (1967).

For quantitative estimation of fungi the dilution plate method of Waksman (1952) as described by Johnson and Curl (1972) was used, as it allowed qualitative and quantitative assessments. Five grams of sample was shaken by hand for 10 minutes to 20 minutes in 50ml sterile distilled water and successive dilutions were made as required 1:10,000 dilutions were chosen for the quantitative estimation of fungi. 1 ml of dilutant was transferred aseptically into sterile petridishes for each sample and the sterile medium was added. The suspensions were mixed well with the agar by rotating the plate in clockwise and anti-clockwise directions and then allowed to set.

Results and Discussion

The fungal numbers and species were estimated in two Kharif seasons (Kharif season –I and Kharif season -II) and two Rabi seasons (Rabi season –I and Rabi season – II).

Fungal Numbers And Fungal Species From Non-Rhizosphere Soil

The percentage frequency of fungal species isolated from non-rhizosphere soil is depicted in Table: 1 during Kharif season -I. In all 29 fungal species were isolated. The maximum number of fungal species were obtained in sample 2 and 6 and least number of fungal species were recorded in sample three. It was observed that the number of fungal species were higher in later part of the season than in the earlier part of the season.The percentage frequency of fungal species indicate that the Aspergillus fumigatus is most dominant and it is followed by A. Juniculosus. A terreus, Fusarium dimerum. Rhizopus nodoxus, Aspergillus flavus Eaxysporum and Fusarium solani.

Table 2 shows the percentage frequency of major fungal groups isolated from non-rhizosphere soil during Kharif - L. The most dominant fungal groups were Aspergilli followed by Sterile mycelia, Fusaria and Phycomycetes. Aspergilli, Fusaria, Fungi imperfecti and Sterile mycelia were dominant throughout the sampling season.

Table 3 shows the percentage frequency of fungal species isolated from non-rhizosphere soil during Rabi - I. A total of 33 fungal species were isolated during Rabi -1 from non-rhizosphere soil The maximum number of fungal species were isolated from 6th sample and the least number of fungal species were found in 4th sample. The number of fungal species were higher during the later part of the crop season The dominant fungal species was represented by Aspergillus niger followed by Cladosporium cladosporioides. Fusarium dimeram Aspergillus sydowi, Drechslera australiensis, Penicillium varians A. terreus, Esolani, Rhizopus nodosus, Chaetomium aureum, A. flavus, Bahupaathra sp.

Table 4 shows the percentage frequency of major fungal groups isolated from non-rhizosphere soil during Rabi-1. The dominant fungal groups belongs to Aspergilli followed by Fungi imperfecti and Fusaria. Aspergilli, Fungi imperfecti and Sterile mycelia were dominant the sampling season. The Penicillia were found to be throughout dominant in the second sample.

It is evident that from Table 1 and 3 that the number of fungal species isolated during Rabi season-I were more than that of Kharif season - I.

Table: 5 reflects the percentage frequency of fungal species isolated from non-rhizosphere soil during Kharif - II. The highest number of fungal species were isolated from 1st sample. The least number of fungal species were isolated from fourth sample. Higher number of fungal species were isolated during early part of the sampling season than at later part.

In all 38 fungal species were isolated from non-rhizosphere soils during Kharif - II. The dominant fungal species were represented by Fusarium dimerum, Cladosporium cladosporioides, A. niger, A. versicolor, A. nidulans, Fusarium oxysporum, Cercospora sp, Aspergillus fumigatus and Acrophialophora nainiana.

Table :6 shows the percentage frequency of major fungal groups isolated from non-rhizosphere soil during Kharif - II. The dominant groups were Fusaria followed by Sterile mycelia, Fungi imperfecti and Aspergilli which were dominant throughout the sampling season.

The percentage frequency of fungal species isolated from non rhizosphere soils during Rabi season -II is presented in Table: 7. A total of 37 fungal species were isolated. It was observed that the sample 2 and 4 yielded maximum number of fungal species. The least number of fungal species were isolated from the 1st sample. The dominant species were Aspergillus niger. Acrophialophora nainiana, Myrothecium gramineum, Aspergillus nidulans, Aspergillus flavus, Phoma humicola, Cladosporium cladosporioides. Fusarium dimerum, Bahupaathra sp. and Curvularia sp.

Table 8 shows the percentage frequency of major fungal groups isolated from non-rhizosphere soil during Rabi season-II. The dominant group was Sterile mycelia and it was followed by Aspergilli and Fungi imperfecti. It is evident from the data that the number of fungal species isolated during Rabi-I were found to be higher than Kharif-1. However, no significant differences appeared in number of fungal species isolated during Kharif-II and Rabi-II.

Table: 9 shows fungal species isolated from non-rhizosphere soils during Kharif and Rabi seasons together. A total of 68 fungal species were isolated from non-rhizosphere soils. The genus Alternaria was represented by three species. Aspergillus by sixteen, Chaetomium by three, Cladosporoium by three, Colletotrichum by three, Curvularia by three, Drechslera by two, Fusarium by four, Penicillium by three, Phoma by two, Syncephalastrum by two species and other genera represented by one each.

Tables

TABLE 1

Percentage frequency of FungalSpecies	20 D AVG	40 D AVG	60 D AVG	8O D AVG	100 D AVG	1200 AVG	OVERALL AVG
1 Acremonium strictum	2.75	0.46	0.00	0.00	0.00	0.00	0.54
2 Allescheriella Sp .	0.00	0.00	0.00	0.00	0.00	1.61	0.27
3 Aspergillus flavus	17.41	0.51	0.00	2.38	0.00	0.00	3.38
4 Aspergillus fumigatus	65.63	89.97	77.39	10.34	31.75	3.23	46.38
5 Aspergillus funiculosus	0.00	0.46	2.63	25.29	0.00	8.33	6.12
6 Aspergillus luchuensis	0.00	0.21	0.00	0.00	0.00	0.00	0.04
7 Aspergillus nidulans	0.00	3.83	0.00	1.72	0.00	0.00	0.92
8 Aspergillus niger	0.00	0.72	0.00	0.00	0.00	6.05	1.13
9 Aspergillus ochraceous	0.00	0.51	0.00	1.72	0.00	0.00	0.37
10 Aspergillus sulphureus	0.00	0.46	0.00	0.00	0.00	0.00	0.08
11 Aspergillus sydowi	0.00	0.00	4.90	0.00	0.00	6.45	1.89
12 Aspergillus terreus	1.85	1.02	2.27	10.59	0.00	14.55	5.04
13 Aspergillus versicolor fuscus	0.93	0.00	0.00	0.00	0.00	0.00	0.15
14 Aspergillus violaceo - fuscus	0.00	0.21	0.00	0.00	0.00	0.00	0.04
15 Catenularia Sp .	0.00	0.00	0.00	0.00	0.00	8.33	1.39
16 Curvularia lunata	0.00	0.00	0.00	0.00	2.38	0.00	0.40
17 Curvularia Sp .	0.00	0.00	0.00	3.45	0.00	0.00	0.57
18 Drechslera australiensis	0.00	0.00	0.00	5.83	0.00	1.61	1.24
19 Fusarium dimerum	0.00	0.00	0.00	0.00	21.43	1.61	3.84
20 Fusarium oxysporum	0.00	0.00	2.63	3.45	12.70	0.00	3.13
21 Fusarium Sp .	0.00	0.71	0.00	7.14	0.00	0.00	1.31
22 Fusarium solani	1.85	0.00	0.00	0.00	7.14	8.33	2.89
23 Myrothecium gramineum	0.00	0.00	0.00	1.72	0.00	0.00	0.29
24 Penicillium Sp .	0.00	0.00	0.00	0.00	0.00	4.17	0.69
25 Penicillium varians	0.00	0.00	0.00	0.00	0.00	1.61	0.27
26 Phycomyces Sp .	2.78	0.00	0.00	0.00	0.00	4.17	1.16
27 Rhizopus nodosus	0.00	0.00	0.00	0.00	22.22	0.00	3.70
28 Syncephalastrum racemosum	2.00	0.51	0.00	0.00	0.00	0.00	0.42
29 Syncephalastrum Sp .	2.00	0.00	0.00	0.00	0.00	0.00	0.33
STERILE MYCELIA							
BROWN STERILE	0.00	0.00	2.27	3.45	0.00	0.00	0.95
GREY STERILE	0.00	0.00	0.00	7.14	0.00	19.62	4.46
WHITE STERILE	2.78	0.21	7.89	15.76	2.38	9.83	6.47
	99.96	99.75	99.98	99.96		99.99	99.48 99.85
NUMBER OF SPECIES	9	13	5	11	6	6	13

TABLE 2: Percentage frequency of major fungal groups isolated from Non-Rhizosphere soil during Kharif Season I

S.No	FUNGAL GROUPS	Sampling Frequency						
		20 th Day	40 th Day	60 th Day	80 th Day	100 th Day	120 th Day	Overall Average
		1	2	3	4	5	6	
1	PHYCOMYCETES	5.78	0.51	0.00	0.00	22 22	4.17	5.61
2	ASCOMYCETES	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	ASPERGILLI	85.82	97.90	87.19	52.04	31.75	39.01	65 62
4	PENICILLIA	0.00	0.00	0.00	0.00	0.00	5.78	0.96
5	FUSARIA	1.85	0.72	2.63	10.59	41.27	9.94	11.17
6	OTHER FUNGI IMPERFECTI	2.77	0.68	0.02	11.02	2.38	11.65	4.75
7	STERILE MYCELIA	2.78	0.21	10.16	26.35	2.38	29 45	11.89
	TOTAL	100	100	100	100	100	100	100

TABLE 3: Percentage frequency of fungal species isolated from Non-Rhizosphere soil during Rabi Season I

S.No	Species	20 D AVG	40 D AVG	60 D AVG	80 D AVG	100 D AVG	120D AVG	OVERALL AVG
1	Acrophialophora nainiana	5.00	0.00	0.00	0.00	0.00	0.00	0.83
2	Alternaria alternata	0.00	0.00	0.00	0.00	0.00	2.17	0.36
3	Aspergillus flavus	0.00	0.00	0.00	15.38	4.17	0.00	3.26
4	Aspergillus fumigatus	0.00	5.56	0.00	0.00	0.00	0.00	0.93
5	Aspergillus funiculosus	0.00	0.00	0.00	0.00	8.33	0.00	1.39
6	Aspergillus nidulans	0.00	0.93	0.00	0.00	0.00	0.00	0.16
7	Aspergillus niger	25.00	1.85	0.00	38.46	4.17	4.76	12.37
8	Aspergillus sydowi	10.00	23.15	0.00	0.00	8.33	0.00	6.91
9	Aspergillus terreus	0.00	11.11	12.50	3.85	4.17	2.17	5.63
10	Aspergillus unguis	0.00	0.00	0.00	0.00	0.00	2.17	0.36
11	Aspergillus ustus	0.00	0.00	0.00	0.00	0.00	2.38	0.40
12	Aspergillus versicolor	0.00	0.00	9.38	0.00	0.00	0.00	1.56
13	Aureobasidium pullulans	0.00	0.00	0.00	0.00	0.00	2.38	0.40
14	Bahupaathra Sp .	0.00	0.00	15.63	0.00	0.00	0.00	2.61
15	Chaetomium aureum	0.00	0.00	0.00	0.00	16.67	6.52	3.87
16	Cercospora Sp .	0.00	0.00	0.00	0.00	0:00	2.38	0.40
17	Cladosporium cladosporioides	15.00	7.41	0.00	0.00	4.17	38.40	10.83
18	Cladosporium herbarum	0.00	0.00	0.00	0.00	0.00	6.93	1.16
19	Colletotrichum Sp .	0.00	0.93	0.00	11.55	0.00	0.00	2.08
20	Dorstomyces microsporus	0.00	0.00	0.00	0.00	0.00	4.55	0.76
21	Drechslera australiensis	20.00	0.00	18.75	0.00	0.00	0.00	6.46
22	Drechslera hawaliensis	0.00	0.00	0.00	0.00	0.00	2.38	0.40
23	Fusarium dimerum	0.00	0.00	0.00	0.00	37.50	4.55	7.01
24	Fusarium oxysporum	0.00	0.00	0.00	0.00	0.00	4.76	0.79

25	Fusarium solani	0.00	0.00	12.50	3.85	6.25	4.35	4.49
26	Humicola Sp .	0.00	0.00	0.00	0.00	0.00	2.38	0.40
27	Mucor varians	5.00	0.00	0.00	0.00	0.00	0.00	0.83
28	Paecilomyces fusisporus	0.00	0.00	6.25	0.00	0.00	0.00	1.04
29	Penicillium varians	0.00	34.50	0.00	0.00	0.00	0.00	5.75
30	Phoma humicola	0.00	0.93	0.00	0.00	0.00	0.00	0.16
31	Rhizopus nodosus	10.00	5.56	0.00	7.69	0.00	0.00	3.88
32	Scolecobasidium humicola	0.00	0.00	3.10	0.00	6.25	0.00	1.56
33	Yeasts	10.00	0.00	0.00	0.00	0.00	0.00	1.67
	STERILE MYCELIA							
1	ASH STERILE	0.00	0.00	0.00	0.00	0.00	0.00	0:00
2	BROWN STERILE	0.00	4.63	3.10	7.69	0.00	4.55	3.33
3	GREY STERILE	0.00	3.20	0.00	0.00	0.00	0.00	0 53
4	WHITE STERILE	0.00	0.00	18.75	11.54	0.00	217	541
		100.00	99.76	99.96	100.01	100.01	99.95	99.95
	NUMBER OF SPECIES	8	10 .	7	6	10	16	

TABLE 4: Percentage frequency of major fungal groups isolated from Non-Rhizosphere soil during Rabi Season I

	FUNGAL GROUPS	Sampling Frequency						
S.No		20 th Day	40 th Day	60 th Day	80 th Day	100 th Day	120 th Day	Overall Average
		20.00	5.56	0.00	7.69	0.00	0.00	5.54
1	PHYCOMYCETES	10.00	0.00	0.00	0.00	16.67	6.52	5.53
2	ASCOMYCETES	35.00	42.60	21.88	57.69	29.17	11.48	32.97
3	ASPERGILLI	0.00	34.50	0.00	0.00	0.00	0.00	5.75
4	PENICILLIA	0.00	8.84	12.50	3.85	43.75	13.66	13.77
5	FUSARIA	35.00	0.67	43.74	11.54	10.41	61.62	27.16
6	OTHER FUNGI IMPERFECTI	0.00	7.83	21.88	19.23	0.00	6.72	9.28
7	STERILE MYCELIA	100	100	100	100	100	100	100
	TOTAL							

TABLE 5 - Percentage frequency of fungal species isolated from Non-Rhizosphere soil during Kharif Season II

S NO	Species	20D AVG	40D AVG	60D AVG	80D AVG	100 D AVG	120 D AVG	OVERALL AVG
1	Acrophialophora nainiana	0.00	0.00	0.00	0.00	0.00	8.33	1.39
2	Alternaria alternata	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Alternaria atra	1.92	1.0	0.0	0.0	0.0	0.0	049
4	Alternaria Sp .	0.00	0.00	5.50	0.00	0.00	0.00	0.92
5	Aspergillus candidus	0.00	0.00	0.00	0.00	0.00	7.14	1.19
6	Aspergillus fumigatus	0.00	0.00	5.50	0.00	0.00	7.14	2.11
7	Aspergillus funiculosus	0.00	1.00	0.00	0.00	3.85	0.00	0.81

8	Aspergillus nidulans	0.00	0.63	5.50	8.33	12.18	0.00	4.44
9	Aspergillus niger	0.00	1.00	13.19	18.33	0.00	0.00	542
10	Aspergillus sydowi	0.00	0.63	0.00	0.00	0.00	0.00	0.11
11	Aspergillus terreus	2.70	0.00	2.17	0.00	3.85	0.00	145
12	Aspergillus versicolor	0.00	0.00	0.00	20.00	0.00	7.14	4.52
13	Chaetoceratostoma Sp .	0.90	0.00	4.35	0.00	0.00	0.00	0.89
14	Chaetomium aureum	0.00	0.00	0.00	0.00	0.00	7.14	1.19
15	Cercospora Sp .	20.19	0.0	0.0	0.0	0.0	0.0	3.37
16	Cladosporium cladosporioides	7.72	28.88	2.17	0.00	0.00	0.00	6.46
17	Cladosporium oxysporum	1.35	0.00	0.00	0.00	0.00	0.00	0.23
18	Colletotrichum dematium	10.60	0.0	0.0	0.0	0.0	0.0	1.77
19	Colletotrichum falcatum	4.05	5.1	0.0	0.0	0.0	0.0	1.53
20	Colletotrichum Sp .	0.96	0.0	0.0	0.0	0.0	0.0	0.16
21	Curvularia lunata	0.00	0.63	0.00	0.00	0.00	0.00	011
22	Curvularia Sp .	2.70	0.00	0.00	0.00	0.00	0.00	045
23	Drechslera australiensis	1.35	0.00	3.33	0.00	3.85	000	142
24	Fusarium dimerum	32.77	40.13	29.71	16.67	0.00	0.00	19 88
25	Fusarium oxysporum	0.00	0.00	0.00	8.33	8.33	8.33	417
26	Fusarium Sp .	3.85	2.0	0.0	0.0	0.0	0.0	0.98
27	Fusarium solani	0.96	3.13	0.00	0.00	7.70	000	1.97
28	Humicola Sp	0.00	0.0	2.2	0.0	0.0	00	0.36
29	Hyalopus Sp	0.96	0.00	0.00	0.00	0.00	0.00	0.16
30	Mucor varians	0.00	0.00	0.00	0.00	0.00	714	1.19
31	Neocosmospora vasinfecta	0.00	0.6	00	00	00	00	0.11
32	Penicillium citrinum	0.00	3.13	0.00	0.00	0.00	0.00	0.52
33	Penicillium varians	1.35	0.00	0.00	0.00	0.00	0.00	0 23
34	Phoma humicola	0.00	0.6	0.0	0.0	0.0	0.0	0.11
35	Pyrenochaeta Sp .	1.35	0.0	0.0	0.0	0.0	00	0 23
36	Scopulariopsis Sp	0.00	0.00	0.00	0.00	0.00	7.14	1 19
37	Stachybotrys atra	0.00	0.00	0.00	0.00	0.00	7.14	1.19
38	Yeasts	0.00	0.00	4.35	0.00	3.85	0.00	1.37
	STERILE MYCELIA							
1	ASH STERILE	0.00	0.63	2.17	0.00	20	16.67	666
2	BROWN STERILE	0.00	1.00	6.55	10.00	15.38	0.00	5.49
3	3 BLACK STERILE	0.96	0.0	00	18.3	3.9	0.00	3.86
	4 GREY STERILE	0.00	0.0	00	0.0	8.3	0.00	1.39
	5 WHITE STERILE	3.27	9.75	13.33	0.00	8.33	16	8.56
		99.97	99.93	99.99	99.99	100 00	99.98	99 98
	NUMBER OF SPECIES	17	14	11	5	7	9	

TABLE 6- Percentage frequency of major fungal groups isolated from Non-Rhizosphere soil during Kharif Season II

Sampling Frequency								
S.No	FUNGAL GROUPS	20 th Day	40 th Day	60 th Day	80 th Day	100 th Day	120 th Day	Overall Average
1	PHYCOMYCETES	0.00	0.00	0.00	0.00	0.00	15.47	2.58
2	ASCOMYCETES	0.00	0.63	4.35	0.00	3.85	7.14	2.66
3	ASPERGILLI	2.70	3.28	26.38	46.66	19.88	21.42	20.05
4	PENICILLIA	1.35	3.13	0.00	0.00	0.00	0.00	0.75
5	FUSARIA	37.58	45.26	29.71	25.00	16.03	8.33	26.99
6	OTHER FUNGI IMPERFECTI	54.14	36.34	17.53	0.01	3.85	14.30	21.03
7	STERILE MYCELIA	4.23	11.38	22.05	28.33	56.30	33.34	25.95
	TOTAL	100	100	100	100	100	100	100

TABLE 7: Percentage frequency of fungal species isolated from Non-Rhizosphere soil during Rabi Season II

S.No	Species	20 D AVG	40 D AVG	60 D AVG	80 D AVG	100 D AVG	120 D AVG	OVERALL AVG
1	Acrophialophora nainiana	25.00	11.28	0.00	0.00	4.17	0.00	6.74
2	Alternaria atra	0.00	0.00	0.00	0.00	0.00	2.08	0.35
3	Aspergillus flavus	4.17	0.00	0.00	1.79	16.67	0.00	3.77
4	Aspergillus fumigatus	4.17	0.00	0.00	0.00	0.00	0.00	0.69
5	Aspergillus funiculosus	0.00	1.19	1.02	1.79	0.00	0.00	0.67
6	Aspergillus nidulans	4.17	2.17	2.04	4.91	8.33	6.25	4.64
7	Aspergillus niger	8.33	2.17	1.72	15.63	18.75	15.07	10.28
8	Aspergillus ochraceous	0.00	0.00	0.00	4.91	0.00	0.00	0.82
9	Aspergillus sydowi	0.00	0.00	0.00	4.91	0.00	0.00	0.82
10	Aspergillus terreus	0.00	0.00	4.47	3.57	8.33	0.00	2.73
11	Aspergillus versicolor	0.00	0.00	1.02	0.00	0.00	0.00	0.17
12	Aspergillus Sp .	0.00	0.00	0.00	0.00	4.17	4.17	1.39
13	Bahupaathra Sp .	0.00	0.00	0.00	12.95	0.00	0.00	2.16
14	Chaetorium osmaniae	0.00	0.00	0.00	3.13	0.00	0.00	0.52
15	Chaetomium aureum	0.00	0.00	0.00	0.00	0.00	2.08	0.35
16	Cladosporium cladosporioides	0.00	3.57	0.00	0.00	0.00	18.75	3.72
17	Colletotrichum falcatum	0.00	0.00	0.00	0.00	10.42	0.00	1.74
18	Colletotrichum Sp .	0.00	0.00	2.04	0.00	0.00	6.25	1.38

19	Curvularia lunata	12.50	0.00	0.00	0.00	0.00	0.00	2.08
20	Curvularia borrerise	0.00	0.00	0.00	0.00	4.17	0.00	0.69
21	Curvularia Sp .	0.00	5.95	0.00	0.00	0.00	0.00	0.99
22	Drechslera australiensis	0.00	4.35	0.00	0.00	0.00	0.00	0.72
23	Drechslera hawaliensis	0.00	0.00	1.72	1.79	0.00	0.00	0.58
24	Fusarium dimerum	0.00	4.76	0.00	0.00	12.50	0.00	2.88
25	Fusarium oxysporum	0.00	1.19	0.00	6.25	0.00	0.00	1.24
26	Fusarium Sp .	0.00	4.35	0.00	0.00	0.00	0.00	0.72
27	Fusarium solani	0.00	0.00	0.00	0.00	0.00	7.96	1.33
28	Mucor varians	0.00	0.00	0.00	0.00	0.00	2.08	0.35
29	Myrothecium gramineum	0.00	3.36	23.47	3.57	0.00	2.94	5.56
30	Neocosmospora vasinfecta	0.00	3.36	0.00	0.00	0.00	0.00	0.56
31	Penicillium varians	0.00	0.00	5.10	0.00	4.17	0.00	1.54
32	Phoma feckelli	0.00	0.00	3.45	0.00	0.00	0.00	0.57
33	Phoma humicola	0.00	0.00	0.00	1.79	0.00	20.59	3.73
34	Rhizoctonia bataticola	0.00	7.71	0.00	0.00	0.00	0.00	1.29
35	Sclerotium Sp .	0.00	0.00	0.00	4.91	0.00	0.00	0.82
36	Scolecobasidium humicola	0.00	0.00	1.02	0.00	0.00	0.00	0.17
37	Yeasts	0.00	1.19	0.00	0.00	0.00	0.00	0.20
	STERILE MYCELIA							
1	ASH STERILE	4.17	14.29	0.00	3.13	0.00	0.00	3.60
2	BROWN STERILE	8.33	3.36	2.04	3.13	4.17	0.00	3.50
3	GREY STERILE	0.00	5.74	1.72	6.25	0.00	0.00	2.29
4	WHITE STERILE	29.17	19.98	49.15	15.63	4.17	11.76	21.64
		99.99	99.95	99.97	99.99	99.98	99.97	99.97
	NUMBER OF SPECIES	6	14	11	14	10	11	

TABLE 8: Percentage frequency of major fungal groups isolated from Non-Rhizosphere soil during Rabi Season II

		Sampling Frequency						
S.No	FUNGAL GROUPS	20 th Day	40 th Day	60 th Day	80 th Day	100 th Day	120 th Day	Overall Average
1	PHYCOMYCETES	25.00	11.28	0.00	0.00	0.00	15.47	8.63
2	ASCOMYCETES	0.00	4.55	0.00	0.00	3.85	7.14	2.59
3	ASPERGILLI	20.84	5.53	10.27	46.66	19.88	21.42	20.77
4	PENICILLIA	0.00	0.00	5.10	0.00	0.00	0.00	0.85
5	FUSARIA	0.00	10.30	0.00	25.00	16.03	8.33	9.94
6	OTHER FUNGI IMPERFECTI	12.49	17.26	32.48	0.01	3.85	14.30	13.40
7	STERILE MYCELIA	41.67	51.08	52.15	28.33	56.39	33.34	43.83
	TOTAL	100	100	100	100	100	100	100

TABLE 9 Fungal species associated with Non-Rhizosphere soil of Spinacea oleracea (L.) during Kharif and Rabi Seasons

S.NO	SPECIES
1	Acremonium strictum
2	Acrophialophora nainiana
3	Allescheriella Sp .
4	Alternaria alternata
5	Alternaria atra
6	Altemaria Sp .
7	Aspergillus Sp .
8	Aspergillus candidus
9	Aspergillus flavus
10	Aspergillus fumigatus
11	Aspergillus funiculosus
12	Aspergillus humicola
13	Aspergillus nidulans
14	Aspergillus niger
15	Aspergillus ochraceous
16	Aspergillus sulphureus
17	Aspergillus sydowi
18	Aspergillus terreus
19	Aspergillus unguis
20	Aspergillus ustus
21	Aspergillus versicolor
22	Aspergillus violaceo - fuscus
23	Aureobasidium pullulans
24	Bahupaathra Sp .
25	Catenularia Sp .
26	Cercospora Sp .
27	Cercospora Sp . Chaetoceratostoma Sp .
28	Chaetomium aureum
29	Chaetomium osmaniae
30	Chaetomium Sp .
31	Cladosporium cladosporioides
32	Cladosporium herbarum
33	Cladosporium oxysporum
34	Colletotrichum dematium
35	Colletotrichum falcatum
36	Colletotrichum Sp .
37	Curvularia borreriae
38	Curvularia lunata
39	Curvularia Sp .
40	Doratomyces microsporus
41	Drechslera australiensis
42	Drechslera hawallensis
43	Fusarium dimerum
44	Fusarium oxysporum
45	Fusarium solani
46	Fusarium Sp .
47	Humicola Sp .
48	Hyalopus Sp .
49	Mucor varians
50	Myrothecium gramineum
51	Neocosmospora vasinfecta
52	Paecilomyces fusisporus
53	Penicillium Sp .
54	Penicillium citrinum
55	Penicillium varians
56	Phoma fackelli
57	Phoma humicola
58	Phycomyces Sp .
59	Pyrenochaeta Sp .
60	Rhizoctonia bataticola
61	Rhizopus nodosus
62	Sclerotium oryzae
63	Scolecobasidium humicola
64	Scopulariopsis Sp .
65	Stachybotrys atra
66	Syncephalastrum racemosum
67	Syncephalastrum Sp .
68	Yeasts
	STERILE MYCELIA
1	Ash Sterile
2	Black Sterile
3	Brown Sterile
4	Grey sterile
5	White Sterile

Photographs

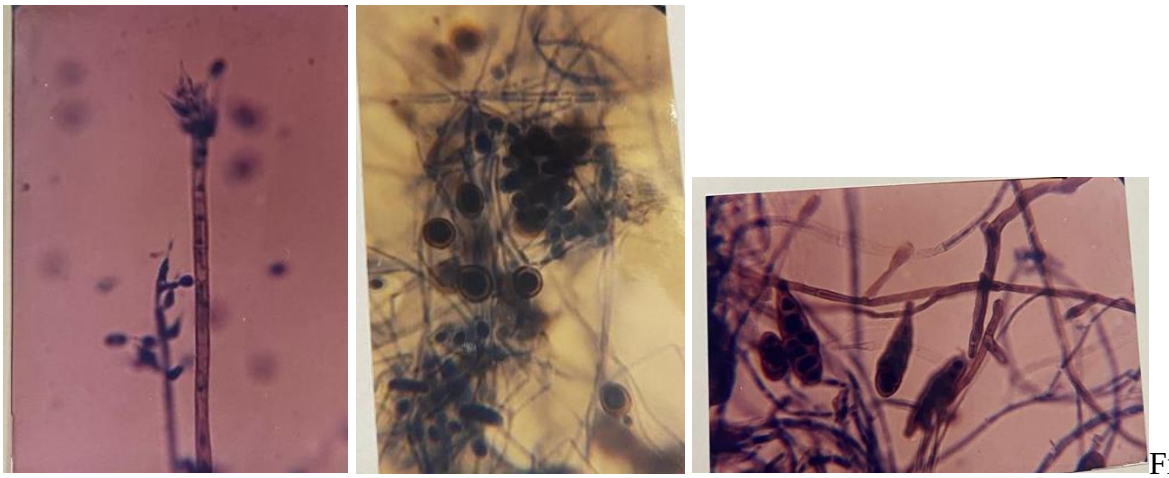

Fig 1, 2, 3

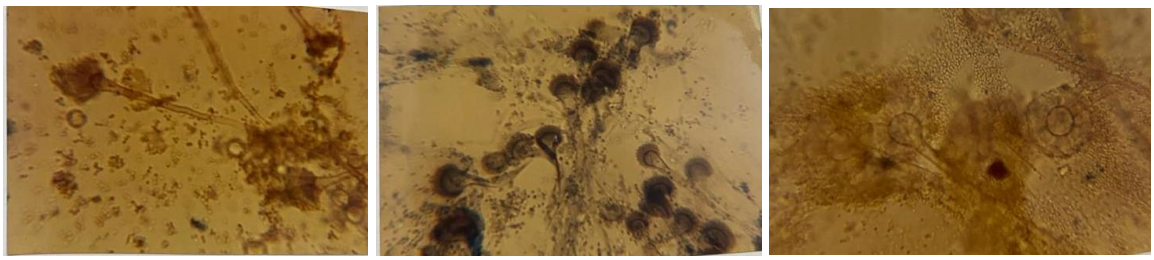

Fig 4, 5, 6

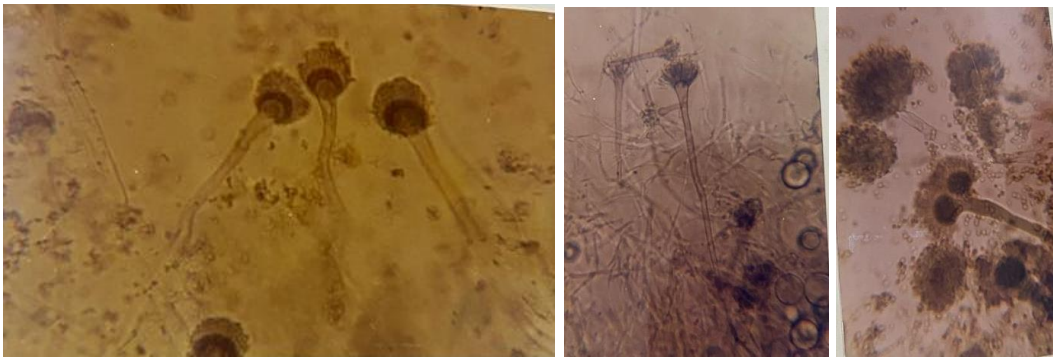

Fig 7,8,9

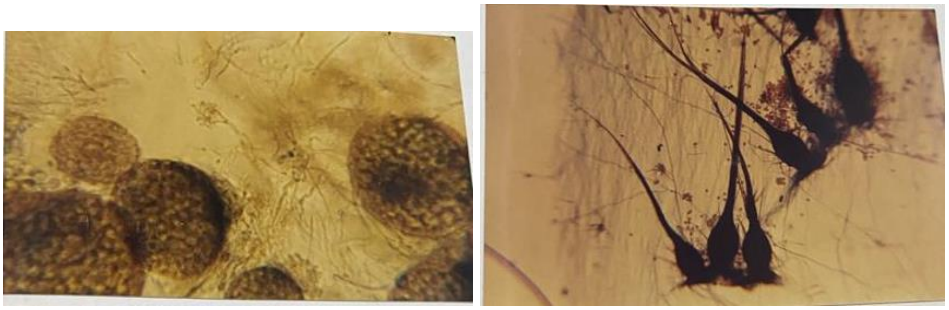

Fig 10, 11


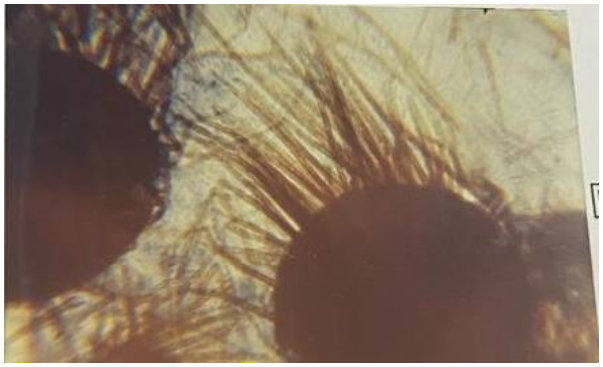

Fig 12, 13

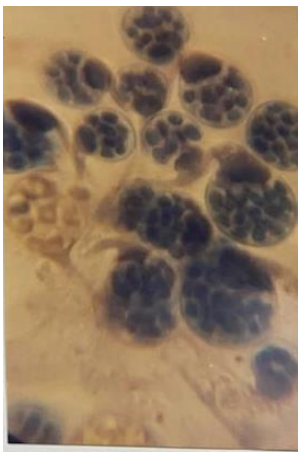
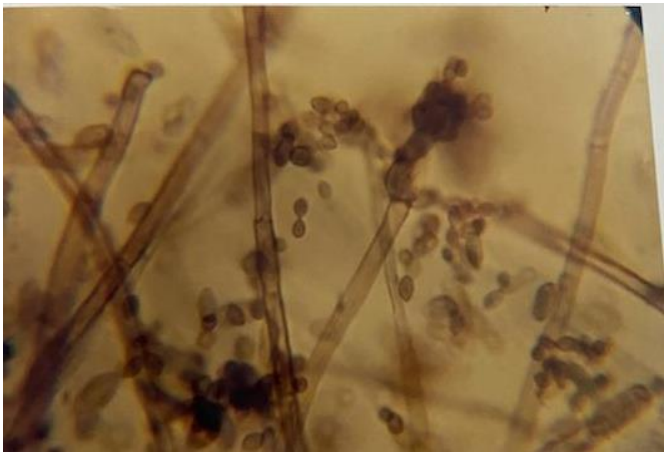

Fig 14, 15

FIGURE 1 Acrophialophora nainiana.Edward. 100X Conidiophores. Phialides and Conidia

FIGURE 2 Allescheriella sp. P. Hennings. 100 X Vegetative mycelium and Aleuriospores

FIGURE 3 Alternaria sp. Nees. 100 X Conidiophores and Conidia.

FIGURE 4 Aspergillus Caespitosus. Raper andThom. 45X Conidiophores with Conidia and Hulle cells

FIGURE 5 Aspergillus Conicus. Blochwitz. 45 X Conidiophores, Plualides and Conidia

FIGURE -6 Aspergillus flavipes. Bainier and Sartory 45 X Conidiophores, Phalides and Conidia

FIGURE -7 Aspergillus fumigatus. Fresenius. 45 X Conidiophores with Conidia and Hulle cells

FIGURE -8 Aspergillus ochraceous. Wilhelm. 45 X Conidiophores, Phialides and Conidia

FIGURE -9 Aspergillus sulphureus. (Fresenius) Thom and Church, 45 X Conidiophores, Phialides and Conidia.

FIGURE 10 Aspergillus variecolor. (Berkeley and Broome) Thom and Raper. 45 X Conidiophores with Conidia and Cleistothecium

FIGURE -11 Chaetoceratostoma sp. Turconi and Maffei, 10 X Perithecia with Ascospores.

FIGURE 12 Chaetomella sp Fuckel. 45 X Pycnidia with Hairs

FIGURE-13 Chaetomium aureum. Chievers. 45 X Perithecia with Asci and Asc spores

FIGURE-14 Circinella ap. Van Tieghem and Le Monti 100x Sporangiphores with Zygopes

FIGURE -15 Cladosporium herbarum (pers) Link 1093 Condophores and Condia

References

1. Booth, C. 1971 a- The genus Fusarium C.M.I. Kew, Surrey, England 1- 237.
2. Chand, H.-1937 - Study of fungus flora of the Lahore soils. Proc. Indian, Acad. Sci.B (5):324-331.
3. Chaudhuri, H. and Sachar 1934 - A study of the fungus flora of Punjab soils. Ann.Mycol.Berlin. 33:90-100.
4. Cholodny, N. 1932- Bev.dt . Bot. Ges. 50:562-70.
5. Gilman, J.C.-1957-A manual of Soil Fungi, 2nd edition. The lowa State University Press, Ames Iowa 450p.
6. Hattori, T. 1973 - Microbial life in the soil - An introduction. Marcel Dekker, New York.
7. Hawksworth, D.L. 1974 Mycologists Hand book - An introduction to the Principles of Taxonomy and nomenclature in the fungi and lichens, CM.I. Kew, England.
8. Bose, R.G. - 1963 - A modified cellulolytic medium for the isolation of cellulolytic fungi from infected materials and soils, Nature 198:505-506.
9. Padma, B. 1995 Microbial ecology of Soil, Rhizosphere, Rhizoplane and Phylloplane of Palak, unpublished Ph.D. thesis submitted to O.U.
10. Pady, S.M., Kramer, C.L. and Clary, R. 1967-J.Allergy 39. 302-10
11. Paine, F.S. 1927 - Studies on the fungus flora of virgin soils. Mycologia, 19: 248-266.
12. Park, D. 1968 - 'The ecology of terrestrial fungi'. In. The Fungi (edited by Ainsworth and Sussan) Vol.III, 5-39p.
13. Parkinson, D. 1957 New methods for the qualitative and quantitative study of fungi in rhizosphere. Symposium, Methods d'Etudes Microbiologiques du sol, Louvain, Belgium, Pedologie (Gand) 7: 146-154.
14. Waksman, S.A. 1944 Three decades with soil fungi. Soil Sci. 58 89-114. Waksman, S.A. 1952 Soil Microbiology. on the of egg plant and New York,
15. Wang, T.S.C., Yang, T.K. and Chuang, T.T.-1967- Soil Science 103: 239-46.
16. Warcup, J.H. 1950 The Soil plate method for isolation of fungi from soil. Nature London, 166:117-118. Warcup, J.H. 1951 Soil steaming, a selective method for fungi from soil. Nature. 166:117-118.